SQA Advanced Graded Unit Specification

General information for centres

This graded unit has been validated as part of the SQA Advanced Diploma in Engineering Systems. Centres are required to develop the assessment instrument in accordance with this validated specification. Centres wishing to use another type of graded unit or assessment instrument are required to submit proposals detailing the justification for change for validation.

Graded Unit title: Engineering Systems: Graded Unit 2

Graded Unit code: HV4A 48

Type of Graded Unit: Project

Assessment Instrument: Project or Assignment

Credit points and level: 2 SQA Credits at SCQF level 8: (16 SCQF credit points at SCQF level 8*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

Purpose: This graded unit is designed to provide evidence that the candidate has achieved the following principal aims, namely to:

1 develop candidates' abilities to apply analysis and synthesis skills to the solution of engineering problems

2 develop the candidate's learning and transferable skills (including core skills).

3 develop a range of communication knowledge and skills relevant to the needs of engineering technicians or incorporated engineers

4 develop applications of knowledge, understanding and skills in an engineering systems approach

5 develop a range of project management skills

6 allow opportunities for specialisation within one or more of the following engineering disciplines: electronics, electrical engineering, engineering practice, fabrication and welding, manufacturing engineering, mechanical engineering and/or mechatronics

Recommended prior knowledge and skills: It is recommended that the candidate should have completed or be in the process of completing the following units relating to the above specific aims prior to undertaking this graded unit:

- Communication: Practical Skills
- Engineering Communication
- Principles of Engineering Systems
- Design for Manufacture
- Engineering Measurement and System Monitoring
- Mathematics for Engineering 1: Mechanical and Manufacturing **OR** Mathematics for Engineering 1: Electronic and Electrical
- Mathematics for Engineering 2
- Principles of Safe Engineering Systems
- Engineering Systems Analysis: System modelling and Control
- Project Management: Managing the Implementation of a Project
- Engineering: Practical Skills
- Business Awareness and Continuing Professional Development
- Engineering Systems: Graded Unit 1 Examination or alternative Graded Unit 1 Examinations

Core skills: The achievement of this unit gives automatic certification of the following core skill:

Problem Solving at SCQF level 6.

There are opportunities to develop the following core skill components in this unit:

Communication: Reading	SCQF level 6
Communication: Written	SCQF level 6
Communication: Oral	SCQF level 6
Working with Others	SCQF level 6

Assessment: This graded unit will be assessed by the use of a project or assignment. The developed project or assignment should provide the candidate with the opportunity to produce evidence that demonstrates she/he has met the aims of the graded unit that it covers.

Administrative information

Graded Unit code: HV4A 48

Graded Unit title: Engineering Systems: Graded Unit 2

Original date of publication: November 2017

Version: 02

History of changes:

Version	Description of change	Date
02	Update of Conditions of Assessment	06/08/2018

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

For further information, please call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

SQA Advanced Graded Unit Specification: instructions for designing the assessment task and assessing candidates

Graded Unit title: Engineering Systems: Graded Unit 2

Conditions of assessment

The candidate should be given a date for completion of the project or assignment. However, the instructions for the assessment task should be distributed to allow the candidate sufficient time to assimilate the details and carry out the assessment task. During the time between the distribution of the assessment task instructions and the completion date, assessors may answer questions, provide clarification, guidance and reasonable assistance.

Reasonable assistance is the term used by SQA to describe the difference between providing candidates with some direction to generate the required evidence for assessment and providing too much support, which would compromise the integrity of the assessment. Reasonable assistance is part of all learning and teaching processes. In relation to the assessment of Advanced Certificate/Diploma project-based Graded Units, assessors may provide advice, clarification, and guidance during the time between the distribution of the project instructions and the completion date, ie at each stage of the project.

Remediation allows an assessor to clarify candidate responses, either by requiring a written amendment or by oral questioning, where there is a minor shortfall or omission in evidence requirements. In either case, such instances must be formally noted by the assessor, either in writing or by recording, and be made available to the internal and external verifier. In relation to Advanced Certificate/Diploma project-based Graded Units, candidates must be given the opportunity for remediation at each stage of the project.

The evidence for an Advanced Certificate/Diploma project-based Graded Unit is generated over time and involves three distinct stages, each of which has to be achieved before the next is undertaken. This means that any re-assessment of stages must be undertaken before proceeding to the next stage. The overall grade is derived from the total number of marks *across all* sections, and should reflect the ability of the candidate to work autonomously and the amount of support required. In relation to Advanced Certificate/Diploma project-based Graded Units, candidates who have failed any stage of the project and have been unable to provide the necessary evidence through remediation must be given the opportunity for re-assessment of that stage.

Any candidate who has failed their graded unit or wishes to upgrade their award must be given a re-assessment opportunity, or in exceptional circumstances, two re-assessment opportunities. In the case of project-based graded units, this must be done using a substantially different project.

The final grading given must reflect the quality of the candidate's evidence at the time of the completion of the graded unit. Candidates must be awarded the highest grade achieved — whether through first submission or through any re-assessment, remediation, and/or reasonable assistance provided.

As part of project activities each candidate should give a 10 minute oral presentation based on her/his project to an audience of at least four people (eg at least three peers and a lecturer). The presentation should be followed by a 5 minute question and answer session. The presentation should be given towards the end of the project.

Instructions for designing the assessment task

The assessment task is a project. The project undertaken by the candidate must be a complex task which involves:

- variables which are complex or unfamiliar
- relationships which need to be clarified
- a context which may be familiar or unfamiliar to the candidate

The assessment task must require the candidate to:

- analyse the task and decide on a course of action for undertaking the project
- plan and organise work and carry it through to completion
- reflect on what has been done and draw conclusions for the future
- produce evidence of meeting the aims which this graded unit has been designed to cover

Guidance on grading candidates

Candidates who meet the minimum evidence requirements will have their achievement graded as C — competent, or A — highly competent or B somewhere between A and C. The grade-related criteria to be used to judge candidate performance for this graded unit is specified in the following table.

Grade-related criteria	
Grade A	**Grade C**
Is a seamless, coherent piece of work which: 1 Includes a project brief that contains complex, multi-variable information about the main technical requirements of the project and provides a cost indication and expected timescales. 2 Contains a project specification which provides clear details of the following: the title of the project; the objectives of the specification; the project's main technical requirements including multi-variables and an acknowledgement of any references or standards relevant to the specification. 3 Includes project objectives that identify the key long term project targets and multi-variables. 4 Includes an initial project schedule (probably in the form of a Gantt chart) which contains a comprehensive list of project activities and timings. The information in the initial schedule is used to assess if the project can be completed within timescales. The schedule is monitored on a regular basis to inform on-going project planning and development.	Is a co-ordinated piece of work which: 1 Includes a project brief that contains all relevant information, is written clearly and concisely and has been agreed fully with the customer. 2 Contains a project specification that is well-structured, contains relevant, accurate information and any revisions made have been agreed with the customer. 3 Includes project objectives which are accurately and fully reflect in the long term project targets. 4 Includes an initial project schedule (probably in the form of a Gantt chart) which shows all essential project activities and timings. Evidence that the schedule has been monitored on at least three separate occasions during the life of the project to inform on-going project planning and development should be available.

Grade A	Grade C
5 The candidate develops a substantial knowledge base to support the demands of the project.	5 The candidate develops a sound knowledge base to support the demands of the project.
6 The selected solution is justified in terms of a thorough evaluation of a range of options.	6 The selected solution is justified in terms of a sound evaluation involving the solution and at least one viable alternative option.
7 A comprehensive verification strategy is developed to ensure the product is completely tested or the investigation findings are fully validated.	7 A verification strategy is developed to test the essential parts of the product or to validate the principal investigation findings.
8 The candidate feeds back to her/his supervisor on a regular basis, updating the supervisor on progress made and actions for the next stages of the project.	8 The candidate feeds back to her/his supervisor on at least three occasions providing an indication of progress made.
9 The candidate accesses components and/or, software and/or materials to support an investigation of the correct specification from a range of sources at the most economic price.	9 The candidate accesses components and/or software and/ or materials to support an investigation of the correct specification from a range of sources
10 The product is constructed to a high standard and functions correctly or the investigation is carried out in a comprehensive manner.	10 The product is constructed to an acceptable standard of quality or the investigation is carried out in a sufficiently detailed manner.
11 All tests on the product are conducted in a technically correct way with due account being taken of inaccuracies introduced by the measurement processes or comprehensive checks are made on investigation data to ensure full confidence in the reliability and accuracy data.	11 Tests are carried out in a technically proficient way or sufficient checks are made on the investigation data to ensure reasonable confidence in the reliability and accuracy of the data.

Grade A	Grade C
12 The interpretation of test results or investigation data is accurate and the analysis of the results or data is used to identify improvements in product performance or the outcomes of the investigation.	12 The interpretation of test results or investigation data is correct.
13 The logbook contains a complex level of detail about project ideas and progress and there is evidence that entries have been made on at least six occasions during the life of the project.	13 The logbook is regularly maintained and provides a detailed, informal record of the candidate's thinking as the project develops including reflective comments.
14 The project report is well-structured, contains only relevant information, has clear and accurate conclusions and recommendations and is written in clear and correct English.	14 The project report meets acceptable standards in terms of structure, use of English and clarity, and has accurate conclusions and recommendations.
15 The project report includes a complex and comprehensive evaluation of the project strategy and activities and includes clear evaluation of what the candidate has learnt from undertaking the project and the factors involved.	15 The project includes an evaluation of the project strategy and activities and includes an evaluation of what the candidate has learnt from undertaking the project.
16 The oral presentation is well-structured, contains only relevant information, is to time and includes the use of appropriate aids.	16 The oral presentation is acceptably structured, contains largely relevant information and is to time.
17 The candidate gives clear, concise and technically accurate answers to questions raised during the oral presentation.	17 The candidate gives technically correct answers to questions raised as part of the oral presentation.

Grade A	Grade C
18 The candidate includes a complex, reflective account of the success, or otherwise, of project activities against project objectives in the oral presentation.	18 The candidate includes a reflective account of the success, or otherwise, of the project in the oral presentation.
19 The candidate undertakes the project with the minimum of supervision.	19 The candidate undertakes the project without unnecessary interventions from the project supervisor to ensure the project remains on track.
20 The candidate identifies clear and full details of the new knowledge and skills she/he has developed as a result of doing the project such as project management skills, investigation/research skills, keeping to deadlines, recognising limitations of knowledge – approaching expert sources.	20 The candidate provides at least three examples of new knowledge and skills she/he has developed as a result of doing the project.
21 The candidate introduces a significant novel feature into the project.	21 None.
22 The candidate demonstrates a high level of self–motivation throughout the project.	22 The candidate demonstrates an acceptable level of motivation throughout the project.
23 The candidate undertakes additional research well beyond that demanded by the project.	23 The candidate takes on a limited amount of additional research.

The project should be marked using the checklist shown on page 9. For each item shown in the checklist an assessor should circle the mark which most closely reflects the candidate's performance against that item. In making a decision regarding which number to circle an assessor should use as her/his frame of reference the Grade A and Grade C criteria shown in the table on the previous pages. Grade C corresponds to 5 and Grade A to 10.

All the circled marks should be added together and the aggregated score entered into the formula shown below to arrive at an overall mark for the project.

$$\text{Overall project mark} = \frac{\text{Aggregated score}}{250} \times 100\%$$

Assessors will then assign an overall grade to the candidate for this graded unit based on the following grade boundaries: A = 70%–100%; B = 60%–69%; C = 50%–59%

Engineering Systems: Graded Unit 2 Project Checklist

Candidate Name: _____ Candidate No: _____ Aggregated Score: _____

No.	Project Item											
1.	Project brief	0	1	2	3	4	5	6	7	8	9	10
2.	Project specification	0	1	2	3	4	5	6	7	8	9	10
3.	Project objectives	0	1	2	3	4	5	6	7	8	9	10
4.	Project schedule	0	1	2	3	4	5	6	7	8	9	10
5.	Knowledge base	0	1	2	3	4	5	6	7	8	9	10
6.	Selected solution	0	1	2	3	4	5	6	7	8	9	10
7.	Verification strategy	0	1	2	3	4	5	6	7	8	9	10
8.	Candidate feedback	0	1	2	3	4	5	6	7	8	9	10
9.	Accessing materials	0	1	2	3	4	5	6	7	8	9	10
10.	Product/investigation construction	0	1	2	3	4	5	6	7	8	9	10
11.	Tests/data checks	0	1	2	3	4	5	6	7	8	9	10
12.	Interpretation of test results or data	0	1	2	3	4	5	6	7	8	9	10
13.	Log book	0	1	2	3	4	5	6	7	8	9	10
14.	Project report	0	2	4	6	8	10	12	14	16	18	20
15.	Project report evaluation	0	1	2	3	4	5	6	7	8	9	10
16.	Oral presentation	0	2	4	6	8	10	12	14	16	18	20
17.	Question and answers	0	1	2	3	4	5	6	7	8	9	10
18.	Oral presentation evaluation	0	1	2	3	4	5	6	7	8	9	10
19.	Level of supervision	0	1	2	3	4	5	6	7	8	9	10
20.	New knowledge and skills developed	0	1	2	3	4	5	6	7	8	9	10
21.	Novel feature	0	1	2	3	4	5	6	7	8	9	10
22.	Level of motivation	0	1	2	3	4	5	6	7	8	9	10
23.	Additional research	0	1	2	3	4	5	6	7	8	9	10

Note: The candidate must achieve all of the minimum evidence specified below for each stage of the project in order to achieve the graded unit.

Evidence requirements

Centres are reminded that project tasks must be unfamiliar and complex.

The project consists of three stages: planning; developing; and evaluating. The following table specifies the minimum evidence required to pass each stage.

Note: The candidate must achieve **all of the minimum evidence** specified below for each stage of the project in order to pass the graded unit.

Project stage	Minimum Evidence Requirements
Stage 1 — Planning	♦ The task undertaken by the candidate must be unfamiliar and complex ♦ A project brief identifying customer requirements ♦ A project specification that the customer has agreed ♦ A set of project objectives ♦ A project schedule ♦ Information about the different solutions ♦ Justification of the chosen solution ♦ Verification strategy *The candidate must achieve all of the minimum evidence specified above in order to pass the Planning stage.*
Stage 2 — Developing	♦ Practical outputs from the project (design, analysis, installation or investigation etc) ♦ Written records of progress underpinning the project such as: — Log book — Progress reports — Test results or investigation findings as part of the verification strategy ♦ Complies with Health and Safety requirements *The candidate must achieve all of the minimum evidence specified above in order to pass the Developing stage.*

Project stage	Minimum Evidence Requirements
Stage 3 — Evaluating	♦ Review of project specification as the project progresses ♦ Review of project schedule as the project progresses ♦ Analysis used to decide project option ♦ Progress reporting and goal setting as part of project implementation ♦ Actions taken to overcome unforeseen circumstances ♦ Interpretation of test results or investigation findings ♦ Action taken as a result of test results or investigation findings interpretation ♦ An assessment of the strengths and weaknesses of the practical output of the project ♦ An evaluation of the extent to which the project brief and objectives have been overtaken ♦ Reflective part of oral presentation ♦ Indication of any knowledge and skills which have been gained by the candidate ♦ Complies with Health and Safety procedures *The candidate must achieve all of the minimum evidence specified above in order to pass the Evaluating stage.*

The use of the Engineering Systems: Graded Unit 2 Project Checklist on Page 9 ensures the following approximate marks distribution between the Planning, Developing and Evaluating stages of the project:

Project stage	Approximate percentage of marks
Planning	30
Developing	45
Evaluating	25

Support notes

The project may consist of one of the following:

- electromechanical hardware only
- hardware and software
- an engineering systems design (which may include the use of software)
- feasibility investigation of a technical issue leading to a report with a clear set of recommendations

Examples of such projects include:

- the installation of electromechanical equipment (eg item of plant equipment, small assembly line etc with associated electrical and mechanical services)
- programming PLC(s) and interfacing PLC(s) to control variables in an engineering system
- design of some form of engineering system (eg heating or refrigeration system, lift etc)
- investigation into the procurement and installation of plant for an assembly or manufacturing line

The assessment task requires the candidate to:

- produce a project brief and specification
- produce project objectives which define the long-term project objectives
- draw up an initial project schedule which should be used to inform on-going project planning and development
- justify chosen project solution in relation to one or more alternative solutions
- develop a verification strategy for the project
- feed back to project supervisor on a regular basis
- access components, software, materials for an investigation
- implement project solution
- test product or check investigation data to confirm validity of this data
- analyse test results or investigation data
- maintain a log book throughout the duration of the project
- write a project report which conforms to appropriate report writing standards, includes an evaluation of the project strategy and what the candidate has learnt from undertaking the project
- present details of the project including a reflective account of the project outcomes

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

As part of the second year SQA Advanced Diploma in Engineering Systems programme of study you will have to complete a 2-credit Graded Unit Project. Like the graded unit examination you be eligible to achieve a grade A, B, C or no award.

Engineering technicians and incorporated engineers are frequently asked to get involved in project work. Such work in industry is much more than simply designing and making an item. It starts with understanding the customer requirements and translating these into a project specification and objectives. It leads into proper project scheduling to ensure 'all the elements of the project' come together on time. It then proceeds to implementing the project and applying an appropriate verification strategy to ensure the project is thoroughly tested. There will also be the paperwork that has to be completed at the end of the project. From this you can see that running even a small project in industry can be a complex business requiring good planning and organisational skills.

The Engineering Systems: Graded Unit 2 has been designed to allow you to develop many of the skills you will require to see a project through from start to finish. Such skills will include technical ones, but you will also develop a very important range of non-technical skills which are required to successfully manage a project such as planning and organisation, oral and written communication, customer care, evaluation skills, time management and many more.

The project will be broken down into the following three stages: planning, development and evaluation. Your lecturer will expect you to produce documentation for all three stages. Typical documentation will include a project brief, specification, objectives and schedule, a logbook and a project report. You will also be required to do 10 minute oral presentation about your project followed by a 5 minute question and answer session.

Your lecturer will provide you with a guide on how you should undertake project work.